CLAIMS

We claim:

1. A fuel supply for a fuel cell comprising:

an outer casing containing fuel, and

an information storage device supported by the casing, said information storage device stores encrypted data that is readable by a controller capable of decoding the encrypted data.

2. The fuel supply of claim 1, wherein the data is encrypted and can be decoded by a symmetric-key technique.

3. The fuel supply of claim 1, wherein the data is encrypted and can be decoded by a public-key technique.

4. The fuel supply of claim 1, wherein the fuel supply is a fuel cartridge.

5. The fuel supply of claim 1, wherein the fuel is contained in a liner and the liner is disposed inside the outer casing.

6. The fuel supply of claim 1, wherein the information storage device comprises an electrically erasable programmable read-only memory.

7. The fuel supply of claim 1, wherein the encrypted data is selected from a group consisting of type of cartridge, date the cartridge was manufactured, lot number for the cartridge, sequential identification number assigned to the cartridge, date the information storage device was manufactured, lot number for the information storage device, sequential identification number assigned to the information storage device, machine identification number for the cartridge and/or storage device, shift during which the cartridge and/or storage device were produced, country where the cartridge and/or storage device were produced, facility code identifying the factory where the cartridge and/or storage device were produced, vibration tolerance for the cartridge and other limits for operating parameter, materials used in manufacturing anti-counterfeit information, fuel information, intellectual property information,

safety information, security password, expiration date, shut-down sequence, hot swap procedure, recycling information, reactant information, fuel gage type, fluid sensor information, current fuel level, current ion level in the fuel, number of separations of the cartridge from the fuel cell, number of times that the cartridge was refilled, fuel level on separation of the cartridge from the fuel cell, number of insertions/connections of the cartridge to the fuel cell, fluid level on connection of the cartridge to the fuel cell, maintenance information, marketing information, triggering events, efficiency of the fuel cell and operational history of the fuel cell system.

8. A fuel supply for a fuel cell comprising:

an outer casing containing a fuel, and

an information storage device supported by the casing, said information storage device stores data selected from a group of information consisting of current ion level in the fuel, vibration tolerance for the cartridge, anti-counterfeit information, intellectual property information, security password, expiration date, shut-down sequence, hot swap procedure, fuel gage type, and fluid sensor information,

wherein the group of information is readable by a controller.

9. The fuel supply of claim 8, wherein the information storage device comprises an electrically erasable programmable read-only memory.

10. The fuel supply of claim 9, wherein the group of information is stored on a non-erasable portion of the electrically erasable programmable read-only memory.

11. The fuel supply of claim 8, wherein the controller is located in the fuel cell.

12. The fuel supply of claim 8, wherein the controller is located in an electronic device that the fuel cell powers.

13. The fuel supply of claim 8, wherein the controller is connected to the information storage device by electrical connections.

14. The fuel supply of claim 8, wherein the controller is connected to the information storage device by wireless connections.

15. The fuel supply of claim 8, wherein the fuel supply comprises a fuel cartridge.

16. The fuel supply of claim 8, wherein the fuel is contained in a liner and the liner is positioned inside the outer casing.

17. The fuel supply of claim 8, wherein the controller is located in the fuel cell.

18. The fuel supply of claim 17, wherein the controller is located in an electronic device that the fuel cell powers.

19. The fuel supply of claim 8, wherein the fuel supply is connectable to a pump.

20. The fuel supply of claim 19, wherein the pump is located inside the fuel cell.

21. A fuel supply for a fuel cell comprising

a casing containing fuel, and

a first information storage device disposed to the casing, said first information storage device including a security identification password, wherein

a controller capable of accessing a confirmation password can read said security identification password and compare it to said confirmation password, and when said security identification password matches said confirmation password said controller allows operation of said fuel supply, and when said security identification password does not match said confirmation password said controller prevents operation of said fuel supply.

22. The fuel supply of claim 21, wherein the confirmation password is stored in the controller.

23. The fuel supply of claim 21, wherein the confirmation password is stored on a second information storage device disposed in the fuel cell.

24. The fuel supply of claim 21, wherein the confirmation password is stored on a second information storage device disposed on a pump adapted to transport fuel to the fuel cell.

25. A fuel supply comprising:

a casing containing fuel, said casing including an outlet, and

a first information storage device supported by the casing, said first information storage device including first data,

a refilling device in fluid communication with said outlet, said refilling device including a second information storage device including second data, said second data being different from said first data.

26. The fuel supply of claim 25, wherein a controller is capable of reading the first information storage device and the second information storage device.

27. An information storage device associated with a fuel cell, wherein the information storage device comprises information for a hot swap procedure.

28. The information storage device of claim 27, wherein the information storage device is located in the fuel cell.

29. The information storage device of claim 27, wherein the information storage device is located in an electronic device that the fuel cell powers.

30. The information storage device of claim 27, wherein the information storage device is located in a fuel supply supplying fuel to the fuel cell.

31. The information storage device of claim 27, wherein the hot swap procedure comprises instructions for a controller accessing the information storage device to switch to an alternate

power source for an electronic device that the fuel cell powers and to instruct a pump for pumping fuel to the fuel cell to shut down in accordance to a predetermined sequence when a trigger event occurs.

32. The information storage device of claim 31, wherein the trigger event comprises a removal of a fuel supply containing said fuel for the fuel cell when the electronic device is operational.

33. The information storage device of claim 31, wherein the alternate power source comprises a battery.

34. The information storage device of claim 31, wherein the alternate power source comprises a reserve fuel chamber containing fuel for the fuel cell.

35. The information storage device of claim 31, wherein while using the alternate power the controller writes information to the information storage device.

36. The information storage device of claim 31, wherein the predetermined sequence comprises running the pump using the alternate power source to pump fuel away from an interface between the fuel cell and a fuel supply containing fuel for the fuel cell.

37. The information storage device of claim 30, wherein the alternate power source comprises a battery.

38. The information storage device of claim 30, wherein the alternate power source comprises a reserve fuel chamber containing fuel for the fuel cell.

39. The information storage device of claim 27, wherein the hot swap procedure comprises semaphore."lock" and semaphore."unlock" verbs.

40. A fuel cell system comprising

a controller operatively connected to a first information storage device, a fuel regulator and a fuel cell comprising a membrane exchange member,

wherein the first information storage device is disposed on a fuel supply and contains information relating to the fuel supply, and the controller is capable of reading and writing to the information storage device,

wherein the fuel supply is in fluid communication with the fuel regulator and the fuel regulator is in fluid communication with the fuel cell, such that fuel contained in the fuel supply is transportable to the fuel cell for conversion to electricity, and

wherein the fuel regulator comprises a regulating valve.

41. The fuel cell of claim 40, wherein the fuel supply has an internal pressure that is higher than atmospheric pressure.

42. The fuel cell of claim 40, wherein the fuel regulator further comprises a pump in fluid communication with the regulating valve.

43. The fuel cell system of claim 40, wherein when an electronic device, which the fuel cell powers, is turned on the controller reads the first information storage device and confirms that the fuel supply is compatible with the fuel cell.

44. The fuel cell system of claim 43, wherein the controller instructs the pump to pump fuel from the fuel supply.

45. The fuel cell system of claim 44, wherein the controller regulates the flow rate through the regulator.

46. The fuel cell system of claim 45, wherein the controller sets the size of the opening in the regulating valve to regulate the flow rate.

47. The fuel cell system of claim 45, wherein the controller sets the pump rate to regulate the flow rate.

48. The fuel cell system of claim 40, wherein a second information storage device is associated with the fuel regulator and contains information relating to the fuel regulator and the controller is capable of reading the second information storage device.

49. The fuel cell system of claim 48, wherein the controller is capable of writing to the second information storage device.

50. The fuel cell system of claim 45, wherein the controller reads a fuel gage measuring the remaining fuel in the fuel supply and writes the remaining fuel volume to the first or second information storage device.

51. The fuel cell system of claim 45, wherein the controller ascertains the volume of fuel transported through the fuel regulator with a flow rate and a time period that fuel flows through the fuel regulator.

52. The fuel cell system of claim 49, wherein the controller ascertains the remaining fuel volume using the volume of fuel transported through the fuel regulator and writes to the first or second information storage device.

53. The fuel cell system of claim 49, wherein the controller reads the flow rate from a flow meter.

54. The fuel cell system of claim 45, wherein the controller reads a fuel concentration from a concentration sensor operatively connected to the fuel cell.

55. The fuel cell system of claim 54, wherein the controller alters the flow rate through the fuel regulator to maintain the fuel concentration at a predetermined range.

56. The fuel cell system of claim 55 further comprises a mixing chamber, wherein the mixing chamber comprises fuel transported through the fuel regulator and byproducts produced

by the fuel cell reaction, and the controller maintains the predetermined fuel concentration range by controlling the volume of fuel transported through the fuel regulator.

57. The fuel cell system of claim 55 further comprises a fuel compartment adapted to receive fuel transported through the fuel regulator and a byproduct compartment adapted to receive byproduct produced by the fuel cell reaction, and the controller maintains the predetermined fuel concentration range by individually controlling the flow rate of fuel and byproduct from the fuel compartment and the byproduct compartment to the fuel cell.

58. The fuel cell system of claim 57, wherein the fuel compartment and the byproduct compartment are contained in a mixing chamber.

59. The fuel cell system of claim 40, wherein a third information storage device is associated with the fuel cell and contains information relating to the fuel cell and the controller is capable of reading the third information storage device.

60. The fuel cell system of claim 59, wherein the controller is capable of writing to the third information storage device.

61. The fuel cell system of claim 40 further comprises an ion fuel filter.

62. The fuel cell system of claim 61, wherein the ion fuel filter is disposed on the fuel supply.

63. The fuel cell system of claim 61 further comprises an ion sensor readable by the controller.

64. The fuel cell of claim 40, wherein the regulating valve comprises a flexible microporous membrane is positioned spaced apart from an impervious surface when the flow rate or pressure of fuel is below a predetermined level, and wherein fuel is transported through the pores in the membrane and at least one opening in the impervious surface.

65. The fuel cell of claim 64, wherein when the flow rate or pressure of fuel exceeds the predetermined level, the flexible microporous membrane is deformed such that at least a portion of the membrane contacts the impervious surface.

66. The fuel cell of claim 65, wherein the flexible microporous membrane is fixedly attached to the regulating valve.

67. The fuel cell of claim 66, wherein the flexible microporous membrane stretches when the flow rate or pressure of fuel exceeds the predetermined level.

68. The fuel cell of claim 65, wherein the impervious surface is substantially planar.

69. The fuel cell of claim 65, wherein the impervious surface is substantially non-planar.

70. The fuel cell of claim 65, wherein the impervious surface defines a flow conduit thereon, and said flow conduit is in fluid communication with the at least one opening in the impervious surface.

71. The fuel cell of claim 70, wherein the flow conduit comprises a plurality of radiating legs.

72. The fuel cell of claim 70, wherein the flow conduit comprises a plurality of connecting concentric circles.

73. The fuel cell of claim 70, wherein the flow conduit comprises an inwardly spiral.

74. The fuel cell of claim 65, wherein the regulating valve comprises a plurality of openings in the impervious surface.

75. The fuel cell of claim 74, wherein the openings have different diameters.

76. The fuel cell of claim 65, wherein a filler or retention material is disposed downstream of the at least one opening.

77. The fuel cell of claim 65, wherein a filler or retention material is disposed upstream of the at least one opening.

78. The fuel cell of claim 65, wherein the regulator valve further comprises a seal disposed at the outlet of the regulator valve, such that the seal is opened before fuel can be transported through the regulator valve.

79. The fuel cell of claim 40, wherein the electricity produced by the fuel cell recharges a battery.

80. A fuel cell system comprising:

a controller operatively connected to a first information storage device, a fuel regulator and a fuel cell comprising a membrane exchange member,

wherein the first information storage device is disposed on a fuel supply and contains information relating to the fuel supply, and the controller is capable of reading and writing to the information storage device,

wherein the fuel supply is in fluid communication with the fuel regulator and the fuel regulator is in fluid communication with the fuel cell, such that fuel contained in the fuel supply is transportable to the fuel cell for conversion to electricity, and

wherein the electricity recharges a battery.

81. The fuel cell system of claim 80, wherein the battery is located inside an electronic device.

82. The fuel cell system of claim 80, wherein the battery is located outside an electronic device.

83. The fuel cell system of claim 80, wherein the battery is located on the fuel supply.

84. A filter for use with a fuel cell comprising a medium made from ion-conducting polymer wherein fuel exiting the filter contains less metal ions than fuel entering the filter, wherein the medium comprises a polymer that has been irradiated and sulfonated.

85. The filter of claim 84, wherein the ion-conducting polymer comprises a material selected from a group consisting of polyethylene (PE), polypropylene (PP), polyhexafluoropropylene, polychlorotrifluoroethylene, polytetrafluoroethylene (PTFE), polyvinyl fluoride (PVF), polyvinylidene fluoride (PVDF), copolymers thereof and blends thereof.

86. A filter for use with a fuel cell comprising a medium made from ion-conducting polymer wherein fuel exiting the filter contains less metal ions than fuel entering the filter, wherein polymer comprises unsubstituted alkene copolymerized with a functionalized alkene containing ionizable groups or their precursors, and polymerized alkene and ion groups that are introduced into the membrane afterward.

87. The filter of claim 86 wherein the ion-conducting polymer comprises a polytetrafluoroethylene (PTFE) membrane with a perfluorinated polymer filling the pores of the membrane.

88. The filter of claim 86, wherein the ion-conducting polymer comprises a polyvinyl fluoride (PVC) membrane irradiated in a solution containing about 2.5% chlorosulfonic acid.

89. A filter for use with a fuel cell comprising a medium made from ion-conducting polymer wherein fuel exiting the filter contains less metal ions than fuel entering the filter, wherein the ion-conducting polymer is selected from a group consisting of polystyrene sulfonic acid-polyvinylalcohol copolymer (PSSA-PVA) and polystyrene sulfonic acid-ethylene vinylalcohol copolymer (PSSA-EVOH).

90. A filter for use with a fuel cell comprising a medium made with a metal scavenger wherein fuel exiting the filter contains less metal ions than fuel entering the filter, wherein the metal scavenger binds to the metal ions.

91. The filter of claim 90, wherein the metal scavenger comprises flocculants.

92. The filter of claim 90, wherein the metal scavenger comprises silica gel.

93. The filter of claim 92, wherein the silica gel is selected from a group consisting of 3-(diethylenetriamino) propyl-functionalized silica gel, 2-(4-(ethylenediamino)benzene)ethyl-functionalized silica gel, 3-(mercapto)propyl-functionalized silica gel, 3-(1-thioureido)propyl-functionalized silica gel and triamine tetraacetate-functionalized silica gel.

94. The filter of claim 90, wherein the metal scavenger comprises a metal chelating compound.

95. The filter of claim 94, wherein the metal chelating compound includes ethylenediaminetetraacetate (EDTA).

96. An ion gauge comprising an electrical source and two spaced apart nodes, wherein the electrical source applies a voltage across the two nodes and wherein fuel to be measured is present between the two nodes, wherein a measured electrical property between the two nodes is related to the amount of ions in the fuel.

97. The ion gauge of claim 96, wherein the measured electrical property is the current flowing from one node to the other node.

98. The ion gauge of claim 96, wherein the measured electrical property is the voltage between the two nodes.

99. A method for measuring an ion level in fuel comprising the steps of:
providing an electrical source;
positioning two nodes with the fuel disposed therebetween;
applying a voltage between the two nodes;
measuring an electrical property between the two nodes; and
comparing the measured electrical property to known values.

100. The method of claim 99, wherein the known current values comprises a calibration curve or table.

101. The method of claim 99, wherein the measured electrical property is the current flowing from one node to the other node.

102. The method of claim 99, wherein the measured electrical property is the voltage between the two nodes.